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Résumé de l'article

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The change in wage rates paid in an economy will be affected, in a largely predictable fashion, by the rate of inflation and the current (and recent past) unemployment rates. This well recognized relationship implies that wage inflation is subject to some cyclical variation as originally suggested by Phillips (1958) and Lipsey (1960). An important related question examines the relationship between interindustry wage structure and the business cycle. The purpose of this paper is to formulate a model of cyclical variation in the interindustry wage structure and to test it with data from the Canadian manufacturing sector. This follows in the tradition of Wachter (1970) who addressed this issue with data on the American manufacturing sector and Anderson (1978) who examined the interindustry wage structure for several OECD countries. This paper complements this earlier work by developing an extended model and testing it on Canadian data. Given the close ties between the American and Canadian economies and the importance of the business cycle in determining the interindustry wage structure, the model developed here should be equally applicable to the American and, perhaps, other economies, although such application is not considered in this paper.

The model presented in this paper is similar to the Wachter model, but differs in the measurement of the interindustry wage structure. While Wachter examined a wage spread measure (the coefficient of variation) based on straight time wage rates for the two-digit SIC manufacturing industries, our model focuses on the size of the wage «premium» paid by the high wage industries. The wage premium is chosen in this study due to its intuitive appeal. Most theories of the interindustry wage structure rely on the spread between the high wage and the low wage industries and thus the premium is a good measure for empirical tests. While the coefficient of variation may be a more reliable statistical measure of wage dispersion, in the Canadian case, due to the very slow change in the weights of the high

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wage versus low wage industries which make up the sector wage rates, there is little bias introduced through use of the premium. This paper examines the cyclical variation in this premium using annual data for 1958-1981. Our results indicate the important effects macroeconomic policy can have on the distribution of income through its effects on the economy's wage structure. This model does not attempt to explain the interindustry differences in response to the business cycle nor the cross sectional differences in manufacturing wage rates, rather it examines the broad structure of wages in the economy[1].

This paper tests the hypothesis that the size of the wage premium paid by the high-wage industries in Canada varies systematically over the business cycle. In order to test this hypothesis equal-skill wage rate inequalities are assumed to exist across industries as a result of varying competitive structures in their labour and product markets. In addition, evidence is provided in the section presenting empirical results that the manufacturing industries in Canada can be meaningfully divided into high and low wage sectors, leading to our definition of the wage premium.

The next section of the paper presents the theory underlying the wage premium and describes the model. The section presenting empirical results offers the results of the empirical tests using post-war Canadian data, while the final section elaborates upon some of the implications of our results and presents our conclusions.

A THEORY OF THE WAGE PREMIUM

An examination of average hourly wage rates across Canadian manufacturing industries reveals that the spread of these rates is remarkably consistent over time. There are industries which regularly pay relatively high wages and those that just as regularly pay lower wages. There are several reasons why these differences persist.

A major cause of the differential in average wages paid is differences in the skill mixes of the labour employed in the various industries. This result is to be expected in any neoclassical model of marginal productivity pricing of factors of production.

Secondly, some of the differential is due to factors such as differences in the competitive structure of industrial product and labour markets. There have been periodic suggestions in the literature that concentrated industries, in which firms enjoy some market power, may tend to pay higher than average wages for labour of a given skill[2]. Concentration is thus seen as confering a certain «ability to pay». Similarly, the existence of a powerful union may give organized labour a certain «ability to take» higher wages. As Hendricks (1977) indicates, there is «almost unanimous agreement that higher levels of unionization lead to higher wage levels» (page 487, footnote 3). This is a view strongly supported by trade union leaders and given some

1 In Canada, KUMAN (1975) has considered relative wage differentials on a cross sectional basis.

2 On this, see WEISS (1966) and the citations contained therein.

qualified support by Throop (1968). These non-competitive elements are assumed to persist over time and to contribute to interindustry differences in wages paid for labour of a given skill. In addition, there may be barriers to either occupational or geographical mobility that prevent the elimination of wage differentials across industries.

Finally, there may be particular characteristics of industries which result in the differential in wage rates. If, for example, a steady, loyal work force is necessary to produce an output of high quality, a premium may be paid to slow labour turnover[3]. Premiums paid for this reason will be referred to as being due to the «nature» of the industry.

In order to define the wage premium we assume that the manufacturing industries can be divided into two classes: high-wage industries being those paying an average wage higher than the mean manufacturing wage and low-wage industries, those paying an average wage lower than the mean wage for all manufacturing industries. There are several possible definitions of the wage premium. The definition used in this paper is the ratio of the average wage paid in the high-wage sector to the average wage paid in the low-wage sector. Another definition of the wage premium could be the absolute difference in wage rates between the high wage and low wage industries. However, this definition would pose problems in accounting for the effects of inflation since the level of the high wage and low wage industries' wage rates are different throughout the period and the effect of inflation is to increase the absolute differential regardless of the business cycle. As a result, the relative version of the wage premium is used.

The assumptions of the existence of wage differentials not affected by the business cycle and the definition of the wage premium allow for the hypothesis tested in this paper; namely, that the size of the wage premium varies over the business cycle. The fact that high wage industries pay a wage premium for work of a given skill suggests that such industries will, in effect, be hiring off a queue. The queue will likely include many workers currently employed in low wage industries as well as others currently unemployed.

The business cycle affects the premium through its effects on the queue. The economy-wide rate of unemployment affects the supply of labour available to all industries in this model, but changes in this rate have more immediate impact upon the wage paid by the low wage industries. In tight labour markets, low wage industries may find that they have more trouble finding and keeping workers and their wage rates may have to rise in order for them to maintain a sufficient labour force. High wage industries, on the other hand, have been hiring off a queue so there would seem to be less urgency to their situation. They can be expected, however, to try to maintain their position in the interindustry wage structure in the long run.

In slack labour markets, low wage industries may be able to lower their average wage rate (in real, if not in nominal, terms) and maintain the labour force they need. There are reasons to believe, however, that high wage in-

3 This is examined by SALOP (1973). These are sometimes called non-pecuniary reasons for the wage differential.

dustries will be reluctant or unable, to lower their wages even in this situation. First of all, contract lags may inhibit them and secondly, maintaining their employees' real wages may be important for sustaining loyalty.

In general, then, wage adjustments in low wage industries run cyclically while those in high wage industries may be countercyclical. This would imply a shrinking of the wage premium when unemployment rates are low and a widening when unemployment rates are high. Others have described the advantages for high wage industries in adopting countercyclical wage adjustment policies which just maintain relative standing in the interindustry wage structure[4]. The reason offered for this wage adjustment in the high wage industries include the interest of trade unions in certain minimum rate of wage increase in slack labour markets (even at the expense of some larger increases in tighter markets) and the lags that contract bargaining imposes.

Another reason given for the movement in the wage differential over the business cycle is union versus non-union behaviour. For example, Sargent (1979) develops a model which distinguishes between the skilled and unskilled sectors which results in a narrowing in the difference in wage rates between these sectors during business cycle upturns. In his model, the high-skill sector has a union which sets a fixed nominal wage for high-skill workers. The narrowing of the differential occurs since during an increase in economic activity, the price level rises which reduces the real wage rate for high-skilled workers and, as a result, more of these workers are hired. Given a fixed labour supply, employment of unskilled workers falls because the nominal wage for low-skill workers rises more than proportionately with the price level. Consequently, periods of high output are associated with a narrowing of the difference in wage rates between the high and low skill workers. Inasmuch as high skilled or unionized workers have high wage rates and low skilled or non-unionized workers have low wage rates, this argument can be applied to the model outlined in this paper.

Formally, the model is derived from an industry specific demand and supply of labour of the following form:

$$N^d_{it} = f\ (w_{it}, P_{it}, PROD_{it}, NAT_{it}, R_{it}, NCE_{it}) \quad (1)$$

$$N^s_{it} = g\ (w_{it}, w_{jt}, U_t, PL_t, NCE_{it}) \quad (2)$$

where,

N^d_{it} = demand for labour by the ith industry at time t,

N^s_{it} = supply of labour for the ith industry at time t,

w_{it} = average wage paid by the ith industry at time t,

p_{it} = price of output in industry i at time t,

$PROD_{it}$ = vector of productivity characteristics of different types of labour in industry i at time t,

NAT_{it} = nature of industry i at time t,

4 See WACHTER (1970), page 77.

R_{it} = vector of prices and productivity characteristics of nonlabour factors of production in industry i at time t,

NCE_{it} = noncompetitive elements in industry i's product and labour markets at time t,

PL_t = economy wide price level at time t,

U_t = economy wide rate of unemployment at time t,

w_{jt} = wage rate paid in industry j at time period t.

Included explicitly in these specifications are variables designed to capture facets of the industry which may alter its wage structure. These equations result in an equilibrium nominal wage given by (3),

$$w_{it} = h\ (p_{it}, PROD_{it}, NAT_{it}, R_{it}, NCE_{it}, U_t, PL_t, W_{jt}) \tag{3}$$

Defining the average wage in the high wage sector as w_t^H, and the average wage in the low wage section as w_t^L, the desired wage premium, WP_t^*, is given by,

$$WP_t^* = \frac{w^H{}_t}{w_t^L} = k\left[\frac{PROD_t^H}{PROD_t^L}, \quad U_t\right] \tag{4}$$

Equation (4) implicitly embodies the assumptions with regard to wage differentials outlined above. That is the relationship between the high wage and low wage industries with regard to non-competitive elements (NCE), price and productivity characteristics of nonlabour factors (R), and the nature of these industries have not changed appreciably over time; or, if they have, they are reflected in labour productivity movements. In addition, the desired wage premium assumes that the desired bargaining process takes place in real terms. Hence, relative wages are independent of the price level in equilibrium.

Assuming that the adjustment to this desired premium, WP_t^*, takes place over the business cycle, in disequilibrium the premium is affected by current and past unemployment rates. In addition, the wage structure can be affected in disequilibrium by inflation since industries may differ in their speed of adjustment to changing inflation rates. As inflation shifts labour supply and demand schedules, the low wage industries are forced to make more immediate adjustments in order to ensure an adequate labour force. The suggestion that low wage industries respond more rapidly during periods of high inflation than do high wage industries has been examined by Bronfenbrenner and Holzman (1965) and more recently by Mitchell (1980). This is incorporated into our model by including the inflation rate explicitly. Combining these adjustment elements with equation (4) implies that the actual wage premium, WP_t, will be a function of current and past rates of inflation and unemployment as well as relative productivity levels. As a result,

$$WP_t = s\left[\frac{PROD_t^H}{PROD_t^L}, U_t, U_{t-1}, \ldots, U_{t-m}, \dot{PL}_t, \ldots, \dot{PL}_{t-n}\right] \tag{5}$$

Finally, exogenous shocks to the economy may also have an effect on the wage premium. In Canada, such a «shock» was the Federal Government imposition of wage and price controls in the last quarter of 1975. The possible effect of this program on the interindustry wage structure is also examined in this paper.

EMPIRICAL RESULTS

In specifying the equations to be estimated based on the model outlined previously, the reciprocal of the unemployment rate is used following Wachter (1970). This assumes that at high unemployment rates the interindustry wage structure is relatively insensitive to further increases in unemployment.

A further modification to the model is the inclusion of a dummy variable to test for the possible effects of the 1975-1978 anti-inflation program on the wage premium. Being instituted in October of 1975, the dummy variable is given a value of 0,25 for 1975. The controls were removed by June of 1978 and hence for this year the dummy variable has value 0,5. For 1976 and 1977, when the program was in effect for the entire time, a value of 1,0 is given to this variable. For the other years of the sample it has a value of zero. This program was designed to monitor wage increases especially in the high «profile» industries. Inasmuch as the high profile industries were also high wage industries we might expect that the wage premium would shrink in response to the imposition of these controls. However, if the program was equitably applied across the spectrum of industries this dummy variable would provide no explanation of the movement in the wage premium. Other studies have examined the effect of the controls program on wage changes in aggregate or for particular industries (see, for example, Reid (1979)). This study considers the effect on the interindustry structure of wages rather than the effect on aggregate wage changes.

An intercept provides a measure of the difference in the effect of the non-competitive elements, price and productivity characteristics of non-labour factors between the high wage and low wage industries. This effect is assumed to be constant over time. However, the inclusion of the relative productivity term provides a test of the reasonableness of this assumption, since a statistically significant coefficient would indicate that the structure of the industries within the high and low wage sectors changes over time.

The basic model estimated using annual data from 1958-1981 is of the following form:

$$WP_t = \alpha + \beta\, CNTL_t + \gamma\, PROD_t + \sum_i \delta_i U^{-1}_{t-i} + \sum_j \lambda_j \dot{PL}_{t-j} + e_t \qquad (6)$$

where,

WP = ratio of average high wage industry wage rate to the average low wage industry wage rate;

CNTL = dummy variable included to represent the imposition of the anti-inflation program for 1975-1978;

PROD = ratio of average high wage industry productivity to the average low wage industry productivity (5);

U = national unemployment rate;

$\dot{P}L$ = inflation rate as measured by the rate of change of the CPI;

e = random disturbance term.

The manufacturing industries included in this analysis are the twenty two-digit SIC manufacturing industries which were either consistently high wage or low wage. That is, by examining the average hourly earnings in these industries we were able to classify industries into those which, over the period 1958-1981, were consistently above or consistently below the mean wage rate over all the manufacturing industries. Four of the twenty industries were excluded because they fit into neither group consistently: tobacco products, rubber and plastic products, wood industries and electrical products[6].

Figure 1 provides an indication of the relationship between the ratio of wage rates in the high wage to low wage industries and the unemployment rate. The variation in the wage premium with the business cycle exhibits both a contemporaneous and a lagged component. In general terms, it appears from this figure that during periods of falling unemployment percentage wage gains in the low wage industries outstripped those in the high wage industries, resulting in a smaller wage premium.

Table 1 sets out the results for several alternatives of the basic model given by equation (6). These different formulations are reported to show their sensitivity to various specifications. Regression A of Table 1 is a test of the complete model while regressions B and C are modifications based on the results in regression A. On the basis of these results, it could be suggested that the relative productivity between the high wage industries and the low wage industries has not changed significantly over time. Furthermore, this result, at least in part, justifies the exclusion of the other variables specified in the reduced form (equation (3)) and indicates that the highly significant constant term of the regression is sufficient to capture most of the effects of skill differences between the high and low wage sectors.

The results with regard to the dummy variable for the controls program suggest that there is evidence that the anti-inflation program did, in fact, have some impact on reducing the premium paid by the high wage industries. In particular, as a percentage of the mean of the dependent variable over the sample period, the effect of the controls program was to reduce the premium paid by the high wage industries by some 1,6 percent.

5 Productivity is measured as Gross Domestic Product (millions of 1971$) per person employed.

6 The data used in this study are from various Statistics Canada publications as follows: Unemployment Rate: *The Labour Force,* Statistics Canada, (71-001). The data from 1953-1965 were estimated by adjusting the unemployment rates from the old labour force survey by the ratio of the revised to the old survey for the over-lapping years. Consumer Price Index: *Prices and Price Indexes,* Statistics Canada, (62-002). Wage Rates: *Employment, Earnings and Hours,* Statistics Canada, (72-002). Real Domestic Product: *Calculated from indexes of Real Domestic Product,* Statistics Canada, (61-510).

Figure 1

The Wage Premium and the Unemployment Rate

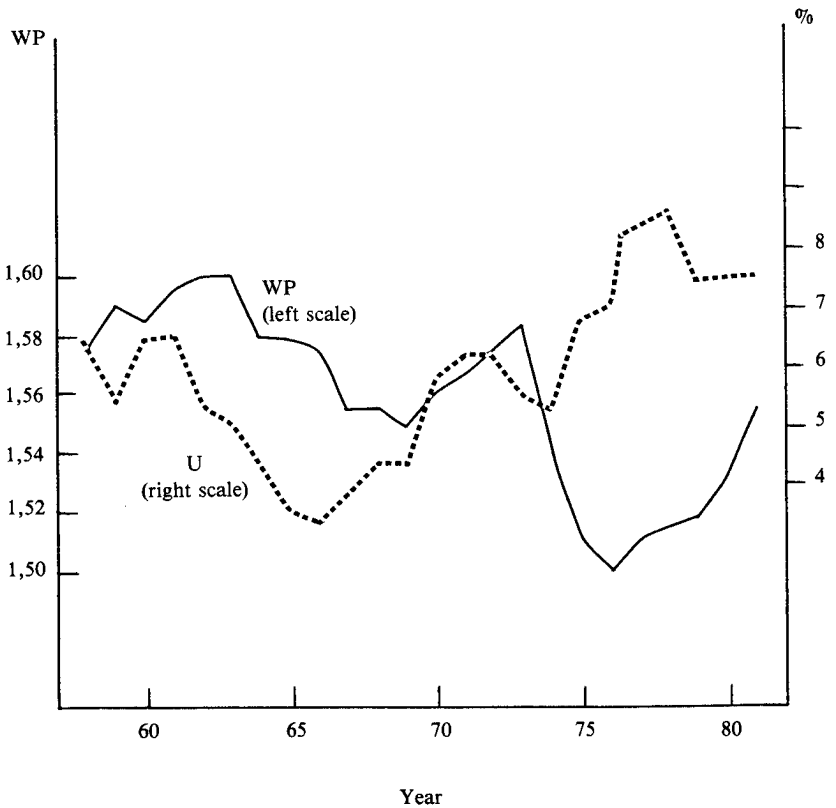

TABLE 1

Estimates of Equation (6)
Annual Data 1958-1981

REGRESSION		*A*	*B*	*C*
Variable				
Constant		1,6549* (15.66)	1,6514* (83.20)	1,6475* (97.77)
Prod		-0,0026 (-0,034)	—	—
Cntl		-0,0250* (-1,96)	-0,0251* (-2,09)	-0,0251* (-2,13)
1/U Lag:	0	-0,0524 (-0,71)	-0,0529 (-0,75)	—
	1	-0,0735* (-2,83)	-0,0736* (-2,94)	-0,1426* (-1,85)
	2	-0,0718* (-2,13)	-0,0717* (-2,20)	-0,0681* (-2,17)
	3	-0,0473* (-1,54)	-0,0472* (-1,57)	-0,0206 (-0,46)
Sum		-0,2451	-0,2454	-0,2313
Mean Lag		1,465	1,461	1,472
PL Lag:	0	-0,0022 (-1,43)	-0,0022* (-1,89)	-0,0020* (-1,73)
	1	-0,0023* (-5,03)	-0,0023* (-7,74)	-0,0024* (-7,74)
	2	-0,0022* (-3,02)	-0,0022* (-3,10)	-0,0022* (-3,43)
	3	-0,0017* (-1,84)	-0,0017* (-1,94)	-0,0018* (-2,14)
	4	-0,0010* (-1,42)	-0,0010* (-1,52)	-0,0010* (-1,68)
Sum		-0,0094	-0,0094	-0,0092
Mean Lag		1,695	1,686	1,741
$\overline{R^2}$		0,8340	0,8438	0,8488
SEE		0,0013	0,0012	0,0012
DW		1,57	1,57	1,57

Notes: t-statistics are reported in the parentheses below the estimated coefficients. $\overline{R^2}$ is the adjusted coefficient of determination; SEE is the standard error of the regression; DW is the Durbin Watson statistics. A* indicates that the coefficient is statistically different from zero at the 0,1 level of significance (one tail test).

Of more interest in this paper are the estimated coefficients on the inflation rate and unemployment rate. Both of these variables were entered as second degree polynomial distributed lags with no near point restriction and the far point constrained to zero. Variations in both the degree of the polynomial and the length of the lag were examined. Although the shape of the lag structure changed slightly, the mean lag did not. Also, longer lags turned out to be insignificant.

Estimated coefficients on both the inflation rate and unemployment rate exhibit signs which conform to the theory of the wage premium, although the estimated coefficient on the current period unemployment rate is insignificant. This is likely due to the slow response of all wage rates to labour market conditions caused by the institutional constraints of contracts. As a result of the insignificance of the current period unemployment rate Version C in Table 1 presents results with the coefficient constrained to zero.

Since it is often argued that the unemployment rate is not a very good measure of labour market conditions, this model was also tested using the unemployment rate for 25-54 year old males (the primary unemployment rate). However, the results did not change significantly and hence are not reported here.

The shape of the lag structure on these estimated coefficients indicates that the effect on the interindustry wage structure of changes in the unemployment rate tends to be faster than for the inflation rate. Hence business cycle effects on the wage premium diminish quite quickly over time (the mean lag is approximately 1,5 years). The impact of the inflation rate has a slightly longer mean lag of around 1,7 years. This longer mean lag may be explained by the existence of one, two and three year contracts in Canada and the way inflation is incorporated into these varying contract lengths.

The estimated coefficients in these regressions are very stable across the different specifications indicating the robustness of the model. In particular, note that the mean lag on both the unemployment rate and the inflation rate remain very similar and the estimated coefficients on the controls program dummy variable are essentially identical across the different regressions.

IMPLICATIONS AND CONCLUSIONS

Since wage rates are directly related to income distribution, the results of this study can be used to indicate the extent that macroeconomic policies which impact upon the rates of inflation or unemployment will also affect the income distribution among wage earners. In particular, as can be seen from Table 2, a chosen policy which yields low inflation rates rather than stressing low unemployment yields a widening of the wage differential between the high wage and low wage industries[7]. On the other hand, a six per-

7 These illustrative figures were computed using results from Regression B, Table 1 using the sum of the lag coefficients.

cent inflation rate results in a significant lowering of the wage premium as the unemployment rate declines. This result suggests that to improve the equality of the income distribution, in terms of reducing the wage premium (should this be considered desirable), macroeconomic policy should strive for lower rates of unemployment since under these conditions the impact of inflation on the premium is somewhat smaller.

The analysis also has some implications for the correct modeling of aggregate wage changes. Consider, for example, a period of tight labour markets. If this follows a period of sustained excess supply in the labour market, the ratio of wage rates in the high wage to low wage industries would be large. However, the low wage industries would be expected to improve their relative wage position due to the tight labour market conditions. This results in a narrowing of the differential given the countercyclical behavior of the high wage industries. Hence, a lower aggregate wage change would be expected than if this had not been examined in a disaggregated way. Consequently, in order to capture business cycle effects on wage changes the results in this paper indicate that some industrial disaggregation is very important.

This paper has demonstrated the cyclical variation of the wage structure in the Canadian manufacturing industries using the concept of a wage premium. The results are shown to be robust to different formulations of the basic model and indicate that both the unemployment rate and the inflation rate effects the wage structure of the manufacturing industry with a mean lag of approximately one and a half years. A further finding of this study is that the anti-inflation program in Canada had a larger effect on the high wage industries than on the low wage industries over the period in which it was in effect.

TABLE 2

Values for the Wage Premium for Selected Inflation and Unemployment Rates in the Long Run

Unemployment Rates	*Inflation Rates*				
	6	*7*	*8*	*9*	*10*
3	1,513	1,504	1,494	1,485	1,476
4	1,534	1,524	1,515	1,505	1,496
5	1,546	1,537	1,527	1,518	1,508
6	1,554	1,545	1,535	1,526	1,517
7	1,560	1,551	1,541	1,532	1,522
8	1,564	1,555	1,546	1,536	1,527

Source: Calculated from Table 1, Regression B.

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